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China Report

SCIENCE AND TECHNOLOGY

No. 127

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APPLIED SCIENCES

SHANGHAI OPTICS, FINE MECHANICS INSTITUTE HOLDS SYMPOSIUM

Shanghai JIGUANG [LASER JOURNAL] in Chinese Vol 8, No 5, 1981 p 27

[Article by Zhang Zechun [1728 3419 4783]: "Shanghai Institute of Optics and Fine Mechanics Holds Fourth Science Symposium"]

[Text] The Shanghai Optics and Fine Mechanics Institute held its fourth science symposium 25 to 27 March 1981. The symposium improved its past method of preselection of papers and reports. The institute's academic committee followed the following principles in reviewing the 167 reports submitted to the symposium and selected 130 papers. It did not select reports that had been published in the various types of academic journals at home and abroad or reports that had been presented at evaluation conferences or various academic conferences held at home or abroad. The reports selected possessed a definite academic standard or applicable value; each person was limited to presenting one report.

At the symposium, 121 academic reports were exchanged and read, including reports on gas lasers, solid gas lasers, semiconductor lasers, dye lasers, mutual reactions between laser and materials, laser materials, light source, film technology, electronics technology, testing technology and information processing technology.

These reports reflected the progress in scientific research in recent years at the Shanghai Optics and Fine Mechanics Institute. For example, such articles as "the submillimicrosecond neodymium phosphate glass laser systems" provide important data and experience for establishing high power large phosphate glass laser systems in the future. "The improvement of the AlGaAs/GaAs multiple layer liquid phase extension system" and "the masking of the selected expansion of Zn of the plane strip laser" and similar reports are the new technological and technical results of research in the gallium arsenide di-isomeric laser conducted at our institute, enabling the percentage of finished products in the manufacture of lasers to reach above 60 percent and the life of the components to last for over 10,000 hours--valuable results for popularization and production. An article on "higher order coherent anti-Stokes and coherent Stokes-Raman scattering" reported that when the 1086 centimeter^{-1} Raman mode of a calcite sample was parallel to the light axis, the first to fifth order CARS spectra and the first and second order CSRS spectra of the calcite could be simultaneously observed. The "study of high velocity flow of large dimension knife plate discharge" has provided the possibility for developing the use of air to replace helium as the medium to expand the discharge dimension and to increase the output power of the high power CO_2 laser. An article on "chromatic dispersion of inorganic glass" discussed the requirements of complete achromatism of modern optical instruments upon the relative partial chromatic dispersion of glass. The computer and chromatic dispersion data of glass were used to compute the characteristic absorption of ultraviolet light of glass, the vibration frequency of infrared light of glass and the force of the vibrator. Their relationship to the composition and structure of glass was shown. A method of calculating the relative partial chromatic dispersion of glass according to the composition of glass was proposed. An article on the "small neodymium pentaphosphate laser" reported on the good progress realized in the total weight of the laser and the function of the laser. The "nth order isolated wave theory" started out from the vectors of the phase space and obtained the general expression of the nth order isolated wave equation and its general solution, the results already obtained have been improved, and the general expression can be used to study the mutual reaction among multiple waves.

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INSTITUTE REPORTS PROGRESS IN LASER CRYSTAL RESEARCH

Shanghai JIGUANG [LASER JOURNAL] in Chinese Vol 8, No 5, 1981 pp 63-64

[Article by Zhang Ying [1728 5391]: "Progress in Laser Crystal Research by the Huabei Photoelectricity Institute in 1980"]

[Text] Breakthrough in Yttrium Lithium Fluoride Laser Crystal Enables Laser To Operate

The YLF laser crystal, with its superior ultraviolet characteristics and its suitability for mixing in many types of rare earth active ions and sensitized ions, can produce laser jumps of more than 20 wavelengths of 0.3 to 0.9 micrometer. It has attracted attention both at home and abroad. During our long period of research, loss of transparency of the crystals was a problem. In 1980, many technological measures were used in the preparation of the raw material and the conditions of growth of the crystals, and a breakthrough was achieved in the technology related to the loss of transparency of the crystals. We obtained three transparent monocrystals: Nd:YLF, Er:YLF and Ho:YLF.

The Nd:YLF laser rod was installed in a specially designed laser for laser tests, and laser operation was realized. Its properties are:

(1) YLF:Nd 1%, ϕ5x47 millimeters.
Laser threshold of 3.7 joules.
Pump energy of 18 joules, laser output of 53.3 millijoules.
Slope efficiency of 0.56%.

(2) YLF:Nd 1%, ϕ5x29 millimeters.
Laser threshold of 3.9 joules.
Pump energy of 18 joules, laser output of 74.62 millijoules.
Slope efficiency of 0.7%.

The Monocrystal Furnace With Automatic Control of Diameter Using an Electron Scale for Laser Crystals Passed Evaluation at the Ministerial Level

The JDL-40 monocrystal furnace for laser crystals jointly developed by our institute and the Shaanxi Mechanics Academy recently passed joint evaluation by the First Ministry of Machine Building and the Fourth Ministry of Machine Building. Efforts are underway for mass production. This monocrystal furnace is designed specifically according to the demands and the characteristics for the growth of laser crystals and incorporates many new technologies. For example, it uses the system of automatic control of diameter by the electron scale; it achieves automatic control of drawing crystals, widening of the shoulders, equalization of the diameter and ending processes. It uses a controllable silicon contravariator matched with a medium-frequency induction heating system and a torque motor drive for crystal pulling and a rotational speed transmission system. It also has a rotational speed program control, temperature measurement device and an alarm to warn of sudden changes in the growth condition. The entire set of equipment has operated steadily and reliably over a long period. The crystals obtained have an even outer shape (the difference in total diameter of the portion of equal diameter of the crystals is ±1%). It has produced superior quality crystals Nd:$YAlO_3$, Nd:Cr:$YAlO_3$, Nd:YAG, and Nd:Cr:YAG (see Figure 1).

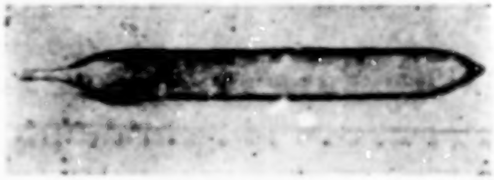

Figure 1. The Nd:YAG crystal grown in the JDL monocrystal furnace.

Evaluation at the ministerial level and by members of the same profession reveals that the JDL-40 monocrystal furnace for laser crystals has reached an advanced domestic level.

Progress Made in the Study of the Function of Cr^{3+} in the Nd:Cr:YAG Crystal

In the past, in the study of the Nd:Cr:YAG crystal abroad, it was believed that while Cr^{3+} has a definite sensitization function, the energy transfer time is long (6.2 milliseconds), and the contribution of sensitization is not large. Also, it was believed that Cr causes definite damage to the optical quality of the crystals. In our research we used the best mixing concentration and technological conditions. We not only proved the sensitization function of Cr^{3+} in the spectrum and laser properties, but we also determined the superiority of the Nd:Cr:YAG crystal in the operation of a continuous laser. Through X-ray diffraction analysis we also proved that because of the different distribution patterns of Nd^{3+}, Cr^{3+} in the crystals, the lattice distortion of the entire YAG crystal rod was improved. In addition, Cr serves to purify harmful impurities in the melt. Using specific amounts of mixture and conditions of growth, we can obtain superior quality crystals without any scattering grains. Thus we refuted the belief held abroad that Cr is harmful to the optical quality of the YAG crystal. Tests of the absorption spectrum and laser tests also show that the anti-ultraviolet irradiation characteristics of the double mixed crystal are better. When irradiated by a 3700 Å pump, the laser rod operates for a long time without producing a chromatic core.

YAG Laser Crystals Produced in Small Amounts

In the studies of the Nd:YAG crystal conducted by our institute over many years, the quality of the crystal gradually improved, the technology of growing crystals stabilized, and we have entered the stage of producing the crystals in small amounts. The laser rods produced are for use by our institute and are also provided in small amounts to domestic users. The properties and quality of the crystals have been praised by the users. Now we are continuing to study the techniques of growing crystals of large dimensions and improving the optical evenness of the crystals.

Standardization of YAG Laser Rod Tests Progresses

As the YAG laser crystal enters into production in small amounts, testing of the properties of the laser rods has gradually progressed toward standardization. Institute level standards are being established for the long pulse laser properties test, continuous laser property tests and the achromatic ratio tests for the YAG laser rod. The energy meter and the power meter are being calibrated according to the standards of the Chinese Measurement Sciences Academy. Conditions for the testing of interference lines are being established. On this basis, we are revising the technical conditions for sample standardization of the YAG laser rods.

Optical Evenness of the Sodium Barium Niobate Crystal Improved

Our institute used the pulling method and stop-and-go rotary growing technique to obtain a BNN nonlinear frequency multiplying crystal of a diameter of 25 millimeters. Observation of the interference lines showed the stop-and-go rotary growing technique can produce crystals with good optical evenness (see Figure 2). Frequency multiplying laser properties tests also preliminarily showed the crystal's superiority.

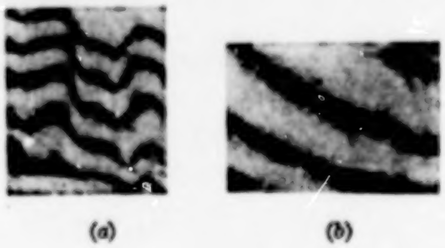
(a) (b)

Figure 2. Interference lines (3.5x) of BNN nonlinear crystals. (a) rotating the crystal at 10 revolutions/minute; (b) rotating the crystal at 0 revolutions/minute.

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FIRST FIBER OPTICS COMMUNICATIONS LINE INSTALLED IN NANJING

Nanjing XINHUA RIBAO in Chinese 7 Jul 81 p 1

[Article by Xu Qisan [1776 0366 0005]: "Nanjing Uses Our Nation's First Optical Fiber Communications Line"]

[Text] Our nation's first optical fiber communications line, 3.2 kilometers long, has successfully gone into operation in Nanjing. Yesterday, the evaluation conference, through which the scientific commission of the Power Ministry provided assistance, ended and the conference satisfactorily concluded the evaluation of the function of this great scientific and technological achievement.

Fiber optics communication is a new communication technology that has developed only in recent years. Compared to metallic wires, optical fibers have many superiorities: their capacity is large--on an optical fiber thinner than a piece of human hair, several hundred thousand telephone channels can be used simultaneously without crosstalk--security is strong, there is no interference from external magnetic fields, insulation is good, they are convenient to install, and they are not affected by lightning or dampness. Therefore, they are receiving popular attention in our nation and in other nations. In the power industry, as the electrical capacity drastically increases, power is transmitted at ultrahigh voltage, the effects of electromagnetic interference and the rise in the ground electrical potential are becoming increasingly serious day by day, and the system of transmission of information is urgently in need of improvement. To utilize fiber optics communications technology to solve this problem, at the end of 1977 the Nanjing Automation Institute established a special staff group, and with the cooperation of the Nanjing Power Supply Bureau, a relatively short time was required to develop an optical fiber communications system, and a 3.2-kilometer-long system was installed between the Nanjing Power Supply Bureau and the Chaotiangong Transformer Station. Since service was started in January of this year, the system has reliably transmitted telephone dispatches, closed circuit television images and telemechanical signals; the major technical indicators have met all the demands. The dispatcher sits in the dispatching room at the Power Supply Bureau and can see the facilities and the operations in the transformer station at Chaotiangong.

Fiber optics communications has great superiority. The photo shows the technicians of the Nanjing Automation Institute utilizing fiber optics communication to clearly observe the situation in the transformer station at Chaotiangong from the Nanjing Power Supply Bureau.

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DEVELOPMENTS IN COMPUTER TECHNOLOGY REPORTED

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in English Vol 18 No 15, 5 Aug 81 p 16

[Text] Position, Role of Computers in National Economy

The author Li Rei, vice-minister of the Fourth Ministry of Machine-Building and Director of the State Administration of Electronic Computer Industry reviewed the application of computers in various branches of national economy in different countries, summarized its importance in modern society, and indicated its impact on various industries and defense.

The author also stressed importance of computers in China's four modernizations and the necessity to accelerate development of China's computer industry.

The China-Made Computer-Laser Typesetting Passed Technical Evaluation

The two-year pilot operation of the first China-made prototype computer-laser precision typesetting system proved, that its design principle is correct and that its system reliability had increased.

The evaluation meeting sponsored in July 1981 by the Ministry of Education and the State Administration on Electronic Computer Industry, indicated, that the hardware performance of the machine is superior to that of the fourth generation Chinese-character laser typesetting system exhibited in Beijing by British Monotype Inc. in 1979, and some of its software typesetting functions had also achieved international level.

The machine has successfully passed the evaluation.

How To Make a General Microcomputer To Have Chinese Character Processing Capability

Beijing Computer Research Institute has succeeded in developing a special software, by which its BCM general microcomputer system can be used as a Chinese Character processing system.

This new software consists of the following modules: the operating system for Chinese character processing, the Chinese character library, the code reference table, the Chinese character generator, etc. By virtue of the operating system for Chinese character processing, the newly developed software can be operated without control by the original CP/M to save storage space. Over 5,000 Chinese characters can be formed by the generator.

The use of this system can be expanded easily to other micro-computer systems, which are based on Z-80 CPU, 64K RAM, floppy disk storage and seven-pin or nine-pin printer. Its design principle can also be applicable to minicomputers.

Software Allows On-Machine Program Error Corrections

The Nanjing Astronomical Instrument Factory has modified and complemented the compiler system and monitor system used for TQ-16, so that both source program and data of basic format scan have functions similar to editor functions in grammar-checking phase and translation [word indistinct] respectively. This facilitates both error analysis and on-machine program modification.

As a result, operation efficiency is increased and machine time saved.

The DJS200/XT1 Operating System

The DJS/XT1 operating system, abbreviated as XT_1, is a general-purpose operating system, developed for DJS200 series machines. It has two versions, XT_1G and XT_1P.

XT_1G uses a drum as its backing storage. It was designed in 1978 and passed evaluation in 1980. The functions provided by XT_1P are: organization, control and management of jobs written in different languages, job spooling; file management; internal storage management and terminal management.

XT_1P uses a disk as its backing storage. It inherits the system architecture of XT_1G, but has expanded functions. XT_1G will [be] put into use in 1982.

News Briefs

According to an agreement between Beijing Electronic Instrument Administration and some Japan companies, microcomputer software exchange between them will be organized, and two technical personnel from China will be sent to Japan for promotional purpose and will stay there for 1-2 years.

An exhibition and sale of China-made computer products sponsored by the State Administration of Electronic Computer Industry will be held from September to October. Best products will be provided to the users by various computer manufacturers.

CSO: 4020/242

SCALE MODEL PLANS MAY ANSWER QUESTIONS ON QIANG-5 AIRCRAFT

Beijing HANGKONG ZHISHI [AEROSPACE KNOWLEDGE MAGAZINE] in Chinese No 8, Aug 81 p 32

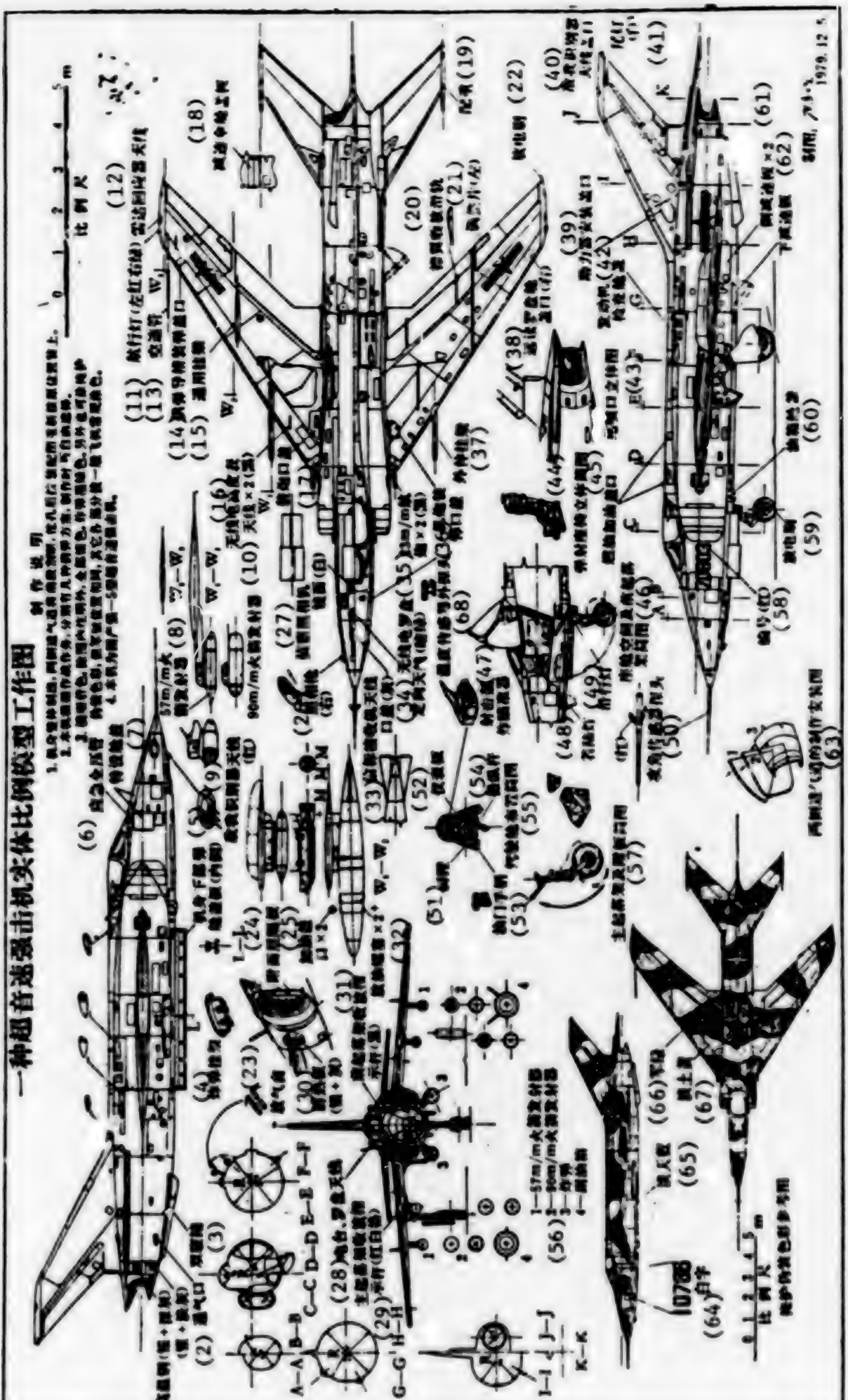
[For photographs of the actual aircraft these scale model plans are based on please see JPRS 74396 of 17 Oct 79 CHINA REPORT, POLITICAL, SOCIOLOGICAL AND MILITARY AFFAIRS, No 25, pp 71-72]

[Text] This aircraft is the Chinese-made Qiang-5 supersonic attack aircraft.

Key to scale model:

1. High-temperature steel
2. Vent
3. Twin ventral fins
4. Bomb racks
5. Ventral bomb bay doors (inner side)
6. Emergency ram intake
7. Special equipment bay cover
8. 57mm rocket launcher pad
9. IFF antenna
10. 90mm rocket launcher pad
11. Navigation light (red on port, green on starboard)
12. Radar responder antenna
13. Pitot tube
14. Missile charging cover [?]
15. General purpose pylon
16. Radio altitude indicator (2 antennas, black)
17. Cannon loading gate cover
18. Drag chute bay door
19. Balancing weight
20. Flap retraction track
21. Trim tab (port)
22. Electrical discharge brush
23. Bleeder
24. Boundary layer divider
25. Fuel cap (X2)
26. Camera bay (starboard)
27. Reconnaissance camera mirror
28. Radio compass antenna

29. Indicator post (red and white) [barber's pole]
30. Blast shield
31. Forward (nose gear) landing gear retract indicator
32. Bleeder
33. Beacon receiver antenna cover
34. Radio compass fixed antenna (dark green)
35. Two 23mm aircraft cannon
36. Cannon ammunition loading gate cover
37. Extended spar
38. Distant-reading compass compartment cover (starboard)
39. Booster [servo] safety hatch
40. IFF antenna hatch opening
41. Tail light (white)
42. Engine inspection hatch
43. Tail pipe, three-dimensional view
44. Simplified three-dimensional view of ejection seat
45. Fuel loading cap
46. Cockpit space and forward landing gear
47. Sights for firing and bombing
48. Landing light
49. Taxing light
50. Angle of attack sensing element [or detector]
51. Diagram of cockpit layout
52. Instrument panel
53. Throttle
54. Control stick
55. Foot pedal
56.
    - 1--57mm rocket launcher pad
    - 2--90mm rocket launcher pad
    - 3--bombs
    - 4--auxiliary fuel tanks
57. Main landing gear [or main undercarriage]
58. Port number (red)
59. Electrical discharge brush
60. Fuel tank bay cover
61. Two side air brakes
62. Ventral air brake
63. Twin air intakes
64. White
65. Light sky blue
66. Army green
67. Light ochre
68. External temperature sensor



一种超音速强击机实体比例模型工作图

POPULATION FORECASTING MODELS, PREDICTIONS DISCUSSED

Shanghai ZIRAN ZAZHI [NATURE JOURNAL] in Chinese No 4, 1981 pp 249-252

[Article by Song Duan Yu [1345 3843 3768], Wuhan Mathematics and Physics Institute, Chinese Academy of Sciences; Shao Kezhen [6730 0668 2182], South Central Academy of Electric Power Design; Jiang Zhongquan [1592 1350 6898], No 1 Metallurgy Company, Ministry of Metallurgy; Wu Weimin [0702 1983 3787], Institute of Rock and Soil Mechanics; Feng Ronghao [1409 2837 6275], South Central Academy of Construction and Design: "Population Forecasting Model and National Population Forecasting"]

[Text] Importance of Population Forecasts

Population is a complex element in society, and it is also a principal part of and a foundation of social activity. The population problem, like other objective matters, possesses its own laws, and has become a science, which increasingly attracts the serious attention of scientists. How to effectively control population has become a problem about which people are more and more concerned in the process of realizing the four modernizations in China. At the present time, the level of China's production is rather low, and there is a vast gap between national average earnings in China and those of advanced countries. If China's national average income is to show fairly great increase by the end of this century, it will be necessary to control the speed of population growth. Population planning requires forecasting the level of population development after the year 2000 on the basis of the present population birth situation in China. Thus, population forecasts can provide precise information for population policies and population planning. Population forecasts differ from meteorological, earthquake, or economic forecasts, and have their own characteristics. The forecast period is not 1 or 2 days, but rather several years or several decades. This article provides a briefing on the model for population forecast calculation methods that we use, and discusses our views about national population forecasting.

Types of Population Forecasts

The traditional concepts of the past on the population development issue must be changed. The longstanding historical idea that "a vast territory with rich resources and a teeming population" is an honor, has been acknowledged to be an arrogance of the Chinese race. Now, we must regard the problem of population development not only as a problem of further population growth, but also regard it as a serious impediment to the four modernizations process that the country faces, which carries with it serious latent political problems. It relates to increases in the standard of living of the present generation, and simultaneously determines what kind of accumulated wealth this generation will leave posterity--hardships or happiness. Thus, population policies must control the present population and institute planned parenthood. Correspondingly, population forecasts should use the mathematical models of controlled population forecasts. If population development is not controlled and people are free to give birth as they please, it will become a free population forecast mathematical model.

We must make population forecast calculations; however, population statistical methods currently are not unified. In using data from population statistics departments, mathematical processing will be required. In the two national population census years of 1953 and 1964, data on population distribution by age and by deaths was generally not available for other years except for individual cities, and so it is recommended that a unified population forecasting mathematical model and commensurate statistical forms be established nationwide.

In our mathematical models, the population birth cycle is a rather major statistical coefficient. The population birth cycle is not derived from legal age, but from the use of statistical methods.

Our mathematical model is calculated on the basis of a closed population system, and for population shifts in each area, consideration must be given to age distributions of those who move, meaning population distribution according to age and distribution of deaths. If this is not done, the accuracy of the forecast will be impaired.

Unless methods are accurate and statistical criteria reasonable, the attainment of fairly high accuracy in figuring population forecasts will be difficult. Song Jian [1345 0256] et al have proposed a series of partial differential equation structural forms on the issue of population control, and have used discretely calculated mathematical models to predict China's population for 100 years, attaining a rather high degree of accuracy, and blazing a trail for the scientific development of China's population system. Here we have adopted the direct calculation method to make population forecasts, and our reasons for emphasizing the direct method are as follows:

1. Population forecasts or other calculations should attain a high degree of accuracy.

2. The layers and bands developed in the historical development of population should be retained. These constitute a special kind of information for population births.

3. The structure of mathematical models should be perceived directly and be easily promoted.

4. Information that satisfies the requirements of other population models (such as working population models, models that show fluctuations in population in enterprises) should be readily separated out of these models.

Statistical Distribution of Three Sets of Population Movements

People's life span and age are calculated in terms of their present age. Population statistics in China today use ages from 0 to 100 as their statistical range, which is called a centenary table. Inasmuch as the number of the population above the age of 100 is fairly small, it is ignored, thus naturally there is some error in this. If a person who lives to maximum age is postulated as age r_m, when the population is counted, it is divided into 0, 1, 2, ..., r_m in an age spread of $r_m + 1$. There are three sets of data in terms of age distribution: First is the number of the population of different ages in any given year, which is termed population distribution according to age, or simply population distribution, which is written as $M_r(t)$, with t standing for the time, and r standing for the range of age, and $r = 0, 1, 2, \ldots, r_m$. Second the number of deaths at different ages in any given year, which is termed distribution of population deaths according to age, or simply distribution of deaths, and written as $M^D_r(t)$, with $r = 0, 1, 2, \ldots, r_m$. Third is the number of women bearing children in any given year, which is termed distribution of childbearing women according to age, or simply distribution of births, and written as $M^0_r(t)$, with $r = n', n' + 1, \ldots, n$. In the distribution of the above three sets of statistics, data about the last set is very difficult to locate in population statistics departments.

In forecast calculations, when T is used as the starting point for any given year, that year is known as the datum year or base year. The sum total of this base year's population distribution $M_r(T)$ is $M_\Sigma(T)$, thus:

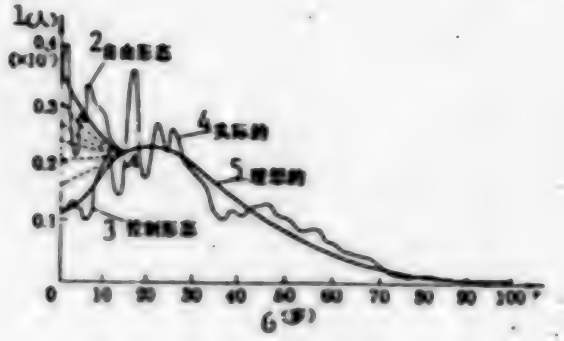
$$M_\Sigma(T)=\sum_{r=0}^{r_m} M_r(T). \qquad (1)$$

We define the proportion of age r males and females $M_r(T)$ in the total population $M_\Sigma(T)$ as the density of population according to age in T year, p (r, T), or density of population distribution, for short,

$$p(r,T)=\frac{M_r(T)}{M_\Sigma(T)} \quad (r=0,\ 1,\ 2,\ \cdots,r_m). \quad (2)$$

Because population distribution may be distinguished as having a controlled configuration or a free configuration, the two are described separately in Illustration 1. Illustration 1 has descriptive curves. The bold line is an ideal situation following an ironing out, while the thin line shows actual fluctuations in population distribution, called the population band. The sections of the curve up to point A show the fluctuations between the controlled configuration and the free configuration. The dotted lines show transitional configurations. After point A, the free configuration, the controlled configuration, and the transitional configuration are combined into a single curve to become a complete population distribution curve of numerous bands.

Illustration 1. Depiction of Population Distribution Configuration



Key:

1. (People)
2. Free Configuration
3. Controlled Configuration
4. Actual
5. Ideal
6. (Age)

Distribution of deaths in the population on the basis of age in T year is M^d_r (T). During any given year, the number of deaths of people of different ages varies, the aged being most numerous, children and middle age people being second, and youths being least. The death rate or death density $\sigma(r, T)_2$ characterizes the distribution of deaths:

$$\sigma(r, T)=M^d_r(T)/M_r(T) \quad (r=0, 1, \cdots, r_m), \tag{3}$$

Its significance is the number of population deaths at age r, M^d_r(T) as a proportion of the population at age r.

us is derived

$$\varphi(r, T)=1-\sigma(r,T) \quad (r=0, 1,\cdots, r_m), \tag{4}$$

which is termed the population survival rate by age range in year T, i.e. the proportion of the surviving population at M_r (T) at the end of year T. These basic concepts are used not only in calculating population forecasts, but are also used in calculating average population longevity.

Distribution of childbearing women by age in T year is M^o_r (T). Presented in the following table is the data we obtained from nearly 10,000 pieces of statistical data on the number of women between the ages of 20 and 43 who gave birth in 1979 among women of childbearing age in a certain prefecture.

Statistics on Number of Childbearing Women in a Certain Prefecture in 1970

Age Range r	Number of Childbearing Women $M^0_r(79)$	Age Range r	Number of Childbearing Women $M^0_r(79)$
20	10	32	318
21	27	33	181
22	59	34	98
23	166	35	78
24	564	36	35
25	1,680	37	29
26	2,690	38	22
27	2,422	39	14
28	1,858	40	4
29	1,402	41	3
30	937	42	2
31	488	43	1

To find the average age, R, of childbearing women,

$$R=\sum_{r=20}^{44} rM^0_r(79) \Big/ \sum_{r=20}^{44} M^0_r(79)=27.43(\text{age}). \qquad (5)$$

This table shows the average age, R, of the childbearing women in that prefecture to have been 27. Thus the population birth cycle R + 1 = 28 is derived, and so 30 years is the population median forecast standard.

The corresponding number of women for the average age, R, of childbearing women is $M_R(T)/2$, because $M_R(T)$ is the sum of the male and female population. In order to simplify calculations, the probability for males and females is half for each, thus, it is multiplied by 1/2. $M_R(T)$ is related to the number of people born i T + 1 year, thus the following formula is established:

$$M_0(T+1)=\lambda(T+1)\,M_R(T) \qquad (6)$$

In this formula $\lambda(T+1)$ is total birthrate, or average birth coefficient, i.e. half the individual number of children born in T + 1 year per every man and wife, which is one-half the average number of births. If $\lambda = 0.5$, the average births per man and wife is one.

Setting up Mathematical Models for Controlled Population Forecasts

Once we have derived the three kinds of distribution given above, we can calculate population forecasts. Our method is the discrete direct recurrence method of calculation. Using this, we first figure out a continuous population development activity formula. Using the rotational movement in ages of the population, we know that this year is age r, and next year is age r + 1. If in a certain area, the number of people at age r in year t is $M_r(t)$, a year later the number of people will be $M_{r+1}(t+1)$, the population delay relationship existing between being:

$$M_{r+1}(t+1)=M_r(t)-M^d_r(t) \qquad (7)$$

By substituting formula (3) in the above, from $\Delta r + \Delta t = 1$ and the total differential definition is derived

$$\frac{\partial M_r(t)}{\partial r} + \frac{\partial M_r(t)}{\partial t} = -\mu(r, t) M_r(t), \quad (8)$$

This is a continuous population development activity formula.

If T is the base year, construct

$$M_r(t)|_{t=T} = M_r(T) \quad (r = 0, 1, \cdots, r_m), \quad (9)$$

This is called formula (8)'s initial condition, while

$$M_r(t)|_{r=0} = M_0(t); \; M_r(t)|_{r=r_m+1} = M_{r_m+1}(t) = 0, \quad (10)$$

is called formula (8)'s border condition.

Thus, formula (8) can be solved under the initial boundary conditions of (9) and (10), and the solution is unique. Formula (8) is considered under the circumstances of a closed system. If there are migrations, the population distribution of the migrants has to be added to the right side of formula (8).

The steps in our recurrent calculations are explained below. We first sought the population distribution and its sum for T + 1 year. We used three statistical distributions, making the population distribution in base year T the initial condition $M_r(T)$ $(r = 0,1,\ldots,r_m)$, M_o (T + 1), i.e. formula (6), and deriving M_Σ (T) from the birth distribution, ^{o}(T + 1) being the control coefficient in the setup. Then formulas (3) and (4) were substituted in (7) to derive

$$M_{r+1}(T+1) = M_r(T)\varphi(r, T). \quad (11)$$

Use of formulas (2), (6), and (11) derived population distribution in T+1 year as follows:

$$\begin{cases} M_0(T+1) = \lambda(T+1) M_R(T) \\ \qquad\qquad = M_\Sigma(T)\lambda(T+1)p(R, T), \\ M_r(T+1) = M_{r-1}(T)\varphi(r-1, T) \\ \qquad\qquad = M_\Sigma(T)p(r-1, T)\varphi(r-1, T) \\ \qquad\qquad (r = 1, 2, \cdots, r_m), \end{cases} \quad (12)$$

In this formula, M_o (T + 1) represents the children born in T + 1 year, with no consideration given to the infant mortality rate, because when counting the number of infants, infant deaths for the year were not treated as birth in the population.

From formula (2) was correspondingly derived the total population in T + 1 year

$$\begin{aligned} M_\Sigma(T+1) &= \sum_{r=0}^{r_m} M_r(T+1) \\ &= M_\Sigma(T)[\lambda(T+1)p(R,T) \\ &\quad + \sum_{r=0}^{r_m-1} p(r, T)\varphi(r, T)]. \end{aligned} \quad (13)$$

Continuing to find out the population distribution and its sum in T + K year. This is figured by using year by year changes in death rate. As a result of social progress, the mortality rate is fairly stable, and can be rendered approximately as:

$$\varphi(r, t) \doteq \varphi(r, T) \quad (t = T+1,\ T+2, \cdots,\ T+k). \tag{14}$$

Through continued application of formulas (6), (11), and (14), population distribution in T + K year was derived as follows:

$$\begin{cases} M_0(T+K) \\ \quad \doteq M_{\Sigma}(T)\lambda(T+K)\beta(R-K \\ \quad +1, T)\varphi(R-K+1,\ T) \\ \quad \cdots\varphi(R-1,\ T), \\ M_1(T+K) \\ \quad \doteq M_{\Sigma}(T)\lambda(T+K-1)\beta(R-K \\ \quad +2, T)\varphi(R-K+2, T) \\ \quad \cdots\varphi(R-1, T)\varphi(0, T), \\ \quad \vdots \\ M_{K-2}(T+K) \\ \quad = M_{\Sigma}(T)\lambda(T+2)\beta(R-1,\ T)\varphi(R \\ \quad -1,\ T)\varphi(0,\ T) \\ \quad \cdots\varphi(K-3, T), \\ M_{K-1}(T+K) = M_{\Sigma}(T)\lambda(T+1)\beta(R,\ T)\varphi(0, T) \\ \quad \cdots\varphi(K-2,\ T), \\ M_K(T+K) = M_{\Sigma}(T)\beta(0, T)\varphi(0, T)\varphi(1, T) \\ \quad \cdots\varphi(K-1,\ T), \\ \quad \vdots \\ M_{r_m}(T+K) = M_{\Sigma}(T)\beta(r_m-K,\ T)\varphi(r_m-K,\ T) \\ \quad \cdots\varphi(r_m-1,\ T) \quad (K = 1, 2, \cdots, k). \end{cases} \tag{15}$$

Thus, the population total correspondingly derived from (15) for T + K year is:

$$\begin{aligned} M_{\Sigma}(T+K) &= \sum_{r=0}^{r_m} M_r(T+K) = M_{\Sigma}(T)\Big[\sum_{j=1}^{K}\lambda(T \\ &+j)\beta(R-j+1, T)\prod_{e=0}^{j-2}\varphi(R-e-1,\ T)\prod_{i=0}^{K-j-1}\varphi(i, T) \\ &+\sum_{r=0}^{r_m-K}\beta(r,\ T)\prod_{e=0}^{K-1}\varphi(r+e,\ T)\Big] \\ &\qquad (K = 1,\ 2, \cdots, k). \end{aligned} \tag{16}$$

By using formula (16) to make calculations, we can forecast any year's population total. Since the $\lambda(t)$ choices differ, various different control programs are derived. For example if for each man and wife there is only a single birth, $\lambda = 0.5$; if two births, $\lambda = 1$.

Setting Up Mathematical Models for Free Population Forecasts

Formula (16) is the calculation method we recommend. In instituting population control in China's present planned births, it is through choice of λ the number of births in the population is regulated. However, some countries with a sparse population encourage births, and when this is done, it is necessary to use a mathematical model for free population forecasts. Instead of trying to determine the corresponding distribution of average reproductive age R, it is necessary to count the number of people born at each age during women's reproductive years, $M^0_r(T)$ (and to further divide the number according to double, triple...), and from these calculations to derive the reproduction probability of women of r age in T year.

$$\alpha(r,T)=M^0_r(T)/M_r(T)\quad(r=n',n'+1,\cdots,n),\tag{17}$$

其中n'为最小生育年龄，n为最大生育年龄.

从公式(17)得出第T+1年的出生人口为

$$\begin{aligned}M_0(T+1)&=\sum_{r=n'}^{n}\alpha(r,T)M_r(T)\\&=M_\Sigma(T)\sum_{r=n'}^{n}\alpha(r,T)p(r,T),\end{aligned}\tag{18}$$

Other distribution of population and control models being the same, the total population derived for T + 1 year is:

$$\begin{aligned}M_\Sigma(T+1)=M_\Sigma(T)\Big[&\sum_{r=n'}^{n}\alpha(r,T)p(r,T)\\&+\sum_{r=0}^{r_m-1}p(r,T)\varphi(r,T)\Big].\end{aligned}\tag{19}$$

以此类推，第T+$\bar m$+1年的人口总和为

$$\begin{aligned}M_\Sigma(T+\bar m+1)=M_\Sigma(T)\Big\{&\sum_{r=n'}^{n}\alpha(r,T)\Big[\sum_{j=1}^{\bar m+1}p(r-j\\&+1,T)\prod_{\iota=0}^{j-1}\varphi(r-\iota-1,T)\prod_{i=0}^{\bar m-j}\varphi(i,T)\Big]\\&+\sum_{r=0}^{r_m-\bar m}p(r,T)\prod_{\iota=0}^{\bar m}\varphi(r+\iota,T)\Big\}\quad(\bar m=1,2,\cdots,m).\end{aligned}\tag{20}$$

National Population Forecast For 100 Years

Inasmuch as the number of immigrants to China may be ignored, [2] the population of the entire country may be regarded as being a closed system, and the population is being controlled; therefore we used formula (16) to draw up a Fortran language program, using a computer to forecast China's population for a hundred years. The annual total population and related criteria were calculated. For calculation porposes, total death rate was 6.1 percent; average reproductive age was 27; and reproduction control coefficients were worked out for three situations with λ= 0.5, 0.75, and 1.0, i.e. each man and woman averaging the birth of 1, 1.5, and 2 children (λ= 0.5 declining in 10 years from λ= 1, while λ+ 0.75 declining gradually over 5 years from λ= 1). Population distribution for the base year was calculated from preliminary data investigated by Comrade Song Jian et al. Ages run from 0 to 114 years old.

Results of calculations show that when λ= 0.5, i.e. a man and woman producing a single child, population will rise from 970-92 million in 1979 to 1,089,730,000 maximum in the year 2000, gradual decline occurring thereafter until the year 2079 when population will decrease to 298.55 million or less than 300 million.

When λ= 0.75, i.e. when each couple produce 1.5 children, population will rise from 970.92 million in 1979 to 1,156,620,000 in the year 2000, reaching a maximum of 1,179,800,000 in the year 2012, thereafter gradually declining to 670.27 million in the year 2079.

If λ= 1, i.e. each couple have two births, the population will be 1,243,070,000 in the year 2000, and reach its zenith at 1,407,540,000 in 2032, thereafter declining until it totals 1,312,260,000 in 2079.

Currently, we currently advocate birth of a single child per couple, in order to bring the population growth rate under control with all possible speed, so that the total national population will be no more than 1.2 billion by the end of this century.

A look at the population of the year 2000 on the basis of the data acquired above shows that if each couple having only a single child can be accomplished, the population in the year 2000 will not exceed 1.09 billion. However, in advocating universal birth of a single child per couple, it is impossible to guarantee that all couples will have only a single chid. Therefore, it is a certainty that by the year 2000, population will exceed 1.09 billion. If each couple gives birth to two children, the population in 2000 will not exceed 1.25 billion, but it will exceed the decided upon objective of 1.2 billion. If half the couples in the country produce one child, and half the couples produce two children, that will mean an average of 1.5 children per couple (of course, in practice it is impossible to tive birth to one and one-half children). Using these calculations, the 2000 population will be 1.156 billion, not exceeding the 1.2 billion figure. Thus, the aforestated objectives are attainable. Inasmuch as minority people areas may continue to have more than two births per couple, the actual year 2000 figure may be a little higher than 1.156 billion. In short, people will have to make an effort to achieve the objective.

The foregoing calculations show that if population is to be controlled at above 1.1 billion and below 1.2 billion within the next 50 years, during this period of time every couple will have to have one and only one child. If each couple is permitted to have only a single child during the next 100 years, the population of China will drop to 300 million. Consequently, it will not be necessary to wait 100 years. By the year 2054, population will drop to the 548 million level of the end of 1949, and other population programs can be formulated. It is not too late to readjust the population reproduction situation; there is no need to worry.

The foregoing gives a general introduction to population forecasting methods and national population forecasting, as well as to other population criteria. Space limitations prohibit giving further detail here.

FOOTNOTES

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TITLE: "Approximate Analytical Solution for the Optimum Cycle Parameters of Turbofan Engines with Equal Total Pressure Mixing Exhaust"

SOURCE: Beijing GONGCHENG REWULI XUEBAO [JOURNAL OF ENGINEERING THERMOPHYSICS] in Chinese Vol 2 No 2, May 81 pp 106-110

TEXT OF ENGLISH ABSTRACT: This paper sets forth an approximate analytical solution for the optimum cycle parameters of turbofan engines with equal total pressure mixing exhaust. With a given bypass ratio, three respective optimum compressor pressure ratios for thrust, s.f.c. and fan pressure ratio may be determined, the last one for both thrust and s.f.c. optimum when reheated.

AUTHOR: JIANG Feng [1203 3536]

ORG: Shenyang Aeroengine Company

TITLE: "A Surge Test of a Twin-shaft Turbojet Engine on Ground Test Bed"

SOURCE: Beijing GONGCHENG REWULI XUEBAO [JOURNAL OF ENGINEERING THERMOPHYSICS] in Chinese Vol 2 No 2, May 81 pp 130-136

TEXT OF ENGLISH ABSTRACT: An instrumentation technique for determining the surge point of a twin-shaft turbojet engine on a ground test bed is presented in this paper. The effectiveness of two surge-inducing methods used in the test is also described in the paper. A practical fuel flow step unit is introduced and the surge point measurement and trace analysis of the engine operating point are discussed.

Typical oscillograms are given which were taken when the engine was surging or not surging during the fuel flow stepping. When the engine was brought to surging, the engine operating point trace diagram was determined by a calculation method based on the flow continuity through nozzle guide vanes of the turbine. This diagram is the final result of the surge point determination technique.

AUTHOR: ZHAO Shichun [6392 0013 2504]

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TITLE: "Effect of Blade Stagger Angle on Performance of a Transonic Compressor with Low Hub-Tip Ratio"

SOURCE: Beijing GONGCHENG REWULI XUEBAO [JOURNAL OF ENGINEERING THERMOPHYSICS] in Chinese Vol 2 No 2, May 81 pp 137-144

TEXT OF ENGLISH ABSTRACT: The effect of the blade stagger angle on the performance of a transonic compressor with low hub-tip ratio is presented in the paper. Because the original single stage compressor failed to achieve the design target, tests were conducted on the compressor with blade twisted and with the stagger angle reduced. The results of these tests indicate that at the design speed and mass flow, the pressure ratio is 1.339 and the efficiency is 0.864, which is 2.2 percent better than the design value and 5 percent better than that of the original single stage. At the same time, the discharge total pressure and temperature profiles are improved substantially, the unevenness of the total pressure profile decreases from 18 to 7 percent and that of the total temperature from 53 to 18 percent, and the operating point of the compressor has been moved from the left to the right of the characteristic line and is located in a high efficiency region.

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TITLE: "Experimental Study of Heat Transfer to Liquid Metal Sodium Flowing in Circular Tube and Annuli"

SOURCE: Beijing GONGCHENG REWULI XUEBAO [JOURNAL OF ENGINEERING THERMOPHYSICS] in Chinese Vol 2 No 2, May 81 pp 173-180

TEXT OF ENGLISH ABSTRACT: This paper presents the heat transfer experiments to liquid metal sodium flowing in a circular tube and annuli, showing the effect of eccentricity on the heat transfer coefficient and the peripheral temperature variation at the rod surface.

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TITLE: "Equilibrium Oxygen Pressure of LD Converter Slag Measured with Oxygen Sensor"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 5, 1981 pp 1-5

TEXT OF ENGLISH ABSTRACT: The oxidizing ability of a steelmaking slag can be expressed in terms of its oxygen pressure. The use of an oxygen sensor with solid electrolyte makes direct and quick determination of oxygen pressure without having to sample and analyze the slag. Among the oxide constituents of steelmaking slags CaO, SiO_2, Al_2O_3, MgO, etc., all are more stable than iron oxides at steelmaking temperatures. Accordingly, the measured oxygen pressure of a slag should be closely related to iron oxides in the slag. Measurements were made on experimental slags under different gas atmospheres in the furnace. It was found that the oxygen pressure of an experimental slag was higher the oxygen atmosphere than under other atmospheres. The oxygen pressure of the experimental slag increased slightly with an increase of ferric oxide under the oxidizing atmosphere, and was mainly affected by the total ferrous oxide in the slag under an argon atmosphere. It increased slightly with the increase of the total ferric oxide in the slag under a reducing

[Continuation of GANGTIE No 5, 1981 pp 1-5]

atmosphere. The oxygen pressure under a highly reducing atmosphere is lower than under other atmospheres when the slag contains an equal ferrous oxide content.

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TITLE: "Laboratory Investigation of Nb Extraction from Molten Iron Containing High Phosphorus"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 5, 1981 pp 6-9

TEXT OF ENGLISH ABSTRACT: An investigation has been made of the recovery of niobium from high phosphorus hot metal in the laboratory. It was shown that the control of the bath temperature from the beginning to the end of blowing is very important and that only in cases of good kinetic conditions can the order of oxidation of elements correspond to thermodynamics, with more ideal selective oxidation being obtained. The number of oxygen nozzles and their distribution in the furnace bottom strongly affect the speed of mixing in the bath as well as kinetic conditions.

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TITLE: "Nb Extraction from Hot Metal Containing Nb and P by Oxygen Bottom-blown Process"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 5, 1981 pp 10-14

TEXT OF ENGLISH ABSTRACT: Slags of high Nb_2O_5, low P_2O_5, high Nb/P ratio and low FeO content have been obtained from hot metal containing Nb and P in 300 kg, 3 and 5 ton experimental oxygen bottom-blown converters. The bottom-blown process showed a good selective oxidation performance. The FeO and P_2O_5 formed at the high oxygen-potential zone near the tuyeres are reduced in the course of ascending by the elements present in the bath that have a higher affinity toward oxygen than do Fe and P. The effects of temperature, depth of metal bath, and diameter of tuyeres on selective oxidation in the bottom-blown process are discussed.

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TITLE: "Making Medium-low Carbon Ferro-Manganese in Basic Oxygen Furnace"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 5, 1981 pp 15-20

TEXT OF ENGLISH ABSTRACT: The key to making medium-low carbon ferromanganese in the basic oxygen furnace is "decarburizing and keeping manganese." A semi-industrial experiment was carried out in a 0.8 ton converter, using hot high-carbon ferromanganese as a raw material. The temperature was controlled in the range of 1750-1960°C, the oxygen consumption about 120-180 m^3/ton, and slag basicity (CaO/SiO_2) 1.1 - 1.2. The carbon content in the products was less than 1.5 percent. The recovery of manganese in all the testing heats was more than 80 percent. In comparison with the silico-thermit process for making medium-low carbon ferromanganese in technology and economy, the process has more advantages.

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TITLE: "Hydrodynamic Modeling of Stirred Desulfurization"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 5, 1981 pp 21-27

TEXT OF ENGLISH ABSTRACT: The mixing phenomenon of powdered desulfurizing agents in liquid iron with a rod stirrer was investigated by means of hydrodynamic modeling with special bubbling-polymerized styrene particles, and an aqueous solution of glycerine. Particle concentration was measured automatically with a helium-neon laser. The relationship between the relative differential concentration of the particles, $(C_0-C)/C_0$, and the modified Froud Number, F'_r, was established by varying the vessel diameter, D_0, depth of charge, H_0, rod diameter, d, its eccentricity, a, and immersion depth, h, and the rotational speed, N, of stirring, as follows: $\frac{C_0-C}{C_0} \times 100 = \exp\left\{4.6 - 840\left[F'r\,\frac{(2a+d)^2}{D_0H_0}\right]\right\}$. Experimental results indicated that increasing the rod diameter did not affect the relative mixing concentration, in the range $1/6 \geq d/D_0 \geq 1/12$. But C/C_0 reached a maximum when h/H_0 = 1/5 - 1/3. If the depth of immersion exceeded the above value, however, C/C_0

[Continuation of GANGTIE No 5, 1981 pp 21-27]

decreased. The optimal eccentricity of the rod stirrer was $2a/D_0 = 1/3 - 1/2$, and the optimal depth of charge was $H_0/D_0 = 1/2 \sim 4/5$. When the modified Froud Number is increased over a certain value, splashing increases seriously. The above conclusions are in good agreement with hot model experiments and may be proposed for scale-up.

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ORG: Research Institute of Shanghai Steel Works No 5

TITLE: "A Study on Countercurrent Continuous Steelmaking"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 5, 1981 pp 28-32

TEXT OF ENGLISH ABSTRACT: Fifteen tests totaling 2640 minutes were performed on a trial plant using a countercurrent stream of oxide slag. The trial plant consisted of a refining channel equipped with 5-6 top blowing oxygen lances, with an output of 2.5 t/h. Tests were made with medium and high P pig iron. As the molten iron was continuously fed into the plant, steel was directly tapped through a siphon spout at the other end. The experiments with the countercurrent principle showed that up to 99.8 percent P and 87 percent S can be removed. The end P content can be lowered to 0.001 percent and desulfidation via gasification can be easily realized. Other advantages include less consumption of raw materials, better thermal efficiency and lower lining wear rate. Calculations confirmed that the above refining effects still have not reached the ideal state. Therefore, this method is thought to be specially suited to the production of super-pure steel.

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TITLE: "An Experimental Study of Rare Earth Metal Additions in the Continuous Casting Process"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 5, 1981 pp 33-38

TEXT OF ENGLISH ABSTRACT: A method of rare earth metal (REM) addition during continuous casting of billets has been developed for the twinstrand caster at the experimental works of the Capital Iron and Steel Company be feeding mischmetal wire into the mold under a protective atmosphere. Experiments were carried out to compare the quality of steel so treated with steel to which no REM had been added. It was discovered that the yield of REM in steel was more than 80 percent and the distribution of REM in the steel was relatively uniform. The solidification structure of the billet with REM was dense, the sensitivity toward internal cracks was reduced greatly and the steel with REM additions was comparatively clean. Since the inclusions in the steel had become small and hard to deform REM containing inclusions, the traverse impact value of the product was markedly improved.

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TITLE: "The Solidification and Structure of Semi-killed Low Alloy Steel Ingot 20 MnNb(b) and 25MnNb(b)"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 5, 1981 pp 39-45

TEXT OF ENGLISH ABSTRACT: This article is based on a pilot run of semi-killed ingots of a small size (about 10 inches across). The following aspects are discussed: 1. The effect of segregation of elements on the structure of semi-killed low alloy steel ingots, taking into consideration the peritectic reaction. 2. The conditions of subsurface hole formation in semi-killed low alloy steel ingots. 3. The "hydrogen" semi-killed ingot structure.

AUTHOR: DOU Shixue [4535 1102 1331]

ORG: Northeast Institute of Technology

TITLE: "Structure and Thermodynamic Properties of Silicate Melts"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 5, 1981 pp 59-67

TEXT OF ENGLISH ABSTRACT: This paper reviews the structure-based thermodynamic models of binary silicates. These models include: Toop and Samis' approach to polymerization-depolymerization equilibrium involving the three forms of oxygen occurring in silicate metals; Masson, Smith and Whiteway's polymerization theory; Kapoor and Frohberg's statistical mechanical calculation; Yokokawa and Niwa's statistical approach; Borgianni and Granati's Monte Carlo calculation; and Lin and Pelton's silicon-oxygen bridge model. These models are discussed and compared by means of the results obtained of activity, mixing free energy and anion distribution. The advantage of the polymer theory over any other is the provision of a direct link between ionic constitution and the thermodynamic properties up to the composition of the formation of the ring structure. The major advantage of Lin and Pelton's model is that it is not restricted to composition of polymer theory. The Monte Carlo calculation will become a potential method in liquid structural research.

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Lasers

AUTHOR: YAN Haixing [0917 3189 2502]

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TITLE: "The Vibrational Relaxation Processes in CO_2-N_2-H_2O Laser System"

SOURCE: Shanghai JIGUANG [LASER JOURNAL] in Chinese Vol 8 No 6, Jun 81 pp 1-8

TEXT OF ENGLISH ABSTRACT: Vibrational relaxation processes and data of the CO_2-N_2-H_2O laser system up to now are surveyed. The data before 1968 are based on Taylor and Bitterman's review. The data are treated with the weighed least square method to get the best fit in the form of $\log_{10}K = A + BX + CX^2 + DX^3$, and the corresponding coefficients are presented. Using these best fits of data and a relaxation model with three modes and four vibrational temperatures based on the present work, numerical calculation results of small signal gain of GDL. agree with those of the experiments, thus eliminating the error introduced by the uncertainties of the relaxation data and model.

AUTHOR: SHAN Zhenguo [0830 2182 0948]

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TITLE: "Research on Infrared Transmission of GaAlAs/GaAs DH Lasers"

SOURCE: Shanghai JIGUANG [LASER JOURNAL] in Chinese Vol 8 No 6, Jun 81 pp 23-27

TEXT OF ENGLISH ABSTRACT: In this paper we describe the arrangement and principle of the infrared transmission technique and report the main results obtained. Our experiments show that the technique is another useful tool in the study of GaAlAs/GaAs DH lasers. The comprehensive photographs obtained, including the epitaxial layers, the structure near the stripe region and emissive pattern of the active region, could not be obtained previously with ordinary microscopes or scanning-electron microscopes.

AUTHOR: ZHAO Yanzeng [6392 3601 2582]
WU Shaoming [0124 1421 2494]

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TITLE: "Effects of Chromium Ion Concentration on the Threshold and Output Energy of Dye Q-switched Ruby Lasers"

SOURCE: Shanghai JIGUANG [LASER JOURNAL] in Chinese Vol 8 No 6, Jun 81 pp 28-31

TEXT OF ENGLISH ABSTRACT: It is shown that there is always a minimum on the threshold-concentration plot for dye Q-switched ruby lasers, which increases with the increasing ratio of cavity loss to ruby length and decreases with the increasing ruby diameter. Efficiency of the Q-switched ruby device increases with chromium concentration in a considerably wide range.

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AUTHOR: LIANG Kejun [2733 0344 0971]

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TITLE: "Technological Developments in Chinese Open Pit Metal Mining"

SOURCE: Beijing YOUSE JINSHU [NONFERROUS METALS] in Chinese No 2, 1981 pp 7-13

TEXT OF ENGLISH ABSTRACT: Modern open pits in China appeared at the beginning of the 20th century. Development of new drilling equipment began in 1958, and in the 70's they began to replace older open pit drilling equipment. At present, rotary drills are employed at large open pits and down the hold hammer drills at medium and small open pits. The churn drill is being eliminated.

Blasting technology has made rapid progress since 1956. In recent years it has been approaching advanced levels of the world in several fields: multiple-short-delay blasting, new explosives and large-scale chamber blast, etc.

The principal loading equipment at Chinese open pits is the 4 m^3 electric shovel. The output of advanced shovels exceeds 1.0 million tons/m^3/year. Now larger shovels with 10~15 m^3 bucket capacity, bucket wheel excavators and front-end-loaders with 5 m^3 capacity are manufactured.

Rail transport is popular in Chinese open pits and much experience has been gained. Truck haulage is widely employed and the use of Chinese trucks is increasing.

[Continuation of YOUSE JINSHU No 2, 1981 pp 7-13]

Great interest is shown in the use of ore passes and belt conveyors in haulage.

Significant achievements have been obtained in many fields of open pit operation, for example, open pit design theory, technical measures to raise overall production capacity, computer applications, mine system engineering and open pit slope stability, etc.

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TITLE: "A Calculation of the Stress in the Friction Wheel of a Koepe Multi-rope Hoist by the Finite Element Method on an Electronic Computer"

SOURCE: Beijing YOUSE JINSHU [NONFERROUS METALS] in Chinese No 2, 1981 pp 14-20

TEXT OF ENGLISH ABSTRACT: The present article sums up the authors' work on the calculation of stress in the friction wheel of the Koepe multi-rope hoist by the finite element method. A comparison of the authors' calculated results represented by the radial flexure curve appearing in this article with the well-known calculated data by O. Popowicz of Germany shows that the former agrees closer with the actual situation. The pattern of the stress distribution found in the present work not only responds to the corresponding effect of the bending moments, but also responds figuratively to the location of action of the friction lining.

As shown by the calculated results, the bending moment and the stress levels for the friction wheel are far below those for the drum of a single-rope hoist. This is because each of the several ropes of the Koepe hoist shares a smaller tension

[Continuation of YOUSE JINSHU No 2, 1981 pp 14-20]

and the friction lining reduces the uniformly distributed load on the friction wheel caused by the ropes. Intermittent action also helps to result in lower loads.

In the last part of the article, it is concluded that the strength of the friction wheel is not necessarily the crucial point in design since the bending moment and stress levels are low. Instead, the authors suggest that a thorough study of the stability of the friction wheel and the residual stress in the welded seams be unfolded.

AUTHOR: FU Zhirong [1381 3112 2837]

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TITLE: "The Application of Superspeed Photography in Parametric Measurement of Industrial Explosive Detonation"

SOURCE: Beijing YOUSE JINSHU [NONFERROUS METALS] in Chinese No 2, 1981 pp 21-25

TEXT OF ENGLISH ABSTRACT: The application of superspeed photographical techniques in measuring detonation parameters of an industrial explosive is described in this paper. Based on the different characteristics of industrial explosives, the various explosive-loading constructions and photographical methods were designed. The measuring problems of the detonating process of industrial explosives and blasting devices were solved. The measurement of the detonating velocity of industrial explosives, the transmission time of the detonating wave of the industrial explosive, lateral diffusive velocity, observation of high frame photography, calculations and analysis of photographical results, etc., are related.

AUTHOR: ZHAO Changli [6392 7022 0500]

ORG: Guangzhou Research Institute of Nonferrous Metals

TITLE: "Magnetic Separator of Vertical Ring Type and Its Application"

SOURCE: Beijing YOUSE JINSHU [NONFERROUS METALS] in Chinese No 2, 1981 pp 37-43

TEXT OF ENGLISH ABSTRACT: This paper describes the structure, performance and separating effect of the vertical ring magnetic separator for weakly magnetizable minerals.

The special feature of the unit is the movement of the separating ring around a horizontal axis. The direction of pulp flow at the bottom feed section of the ring is in opposition to that at the top discharge section (relative to the ring). The ball matrix in the separating chamber turns over after the completion of its separation process every time, making impurities and strong magnetic minerals discharge easily, which often block the matrix space in the horizontal ring type. The blockage problem of the separating annular chamber can be better solved and, concurrently, the auxiliary apparatus reduced, simplifying the flowsheet.

This machine adopts an enclosed magnetic circuit shaped like the Chinese character 日. The unit is small, light and smooth, having a low center of gravity and compact structure. The intensity of the magnetic field is 17,000-20,000 gauss and

[Continuation of YOUSE JINSHU No 2, 1981 pp 37-43]

the unit performance is good. When it was used to separate limonite, a concentrate grading 55.3 percent Fe with a recovery of 88.08 percent was achieved from a feed of 46.15 percent Fe; in separating tailing slimes containing stromite and manganocalcite, a manganese concentrate assaying 21.23 percent Mn with a recovery of 63.47 percent was obtained from a raw material containing 11.30 percent Mn through one roughing and cleaning respectively. Good results can also be obtained from separating wolframite, niobite, spodumene, hornblende, etc.

AUTHOR: CHEN Tingzhong [7115 1656 0022]
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TITLE: "The Technique for Measuring Flowing Film Rate"

SOURCE: Beijing YOUSE JINSHU [NONFERROUS METALS] in Chinese No 2, 1981 pp 44-47

TEXT OF ENGLISH ABSTRACT: In this paper, an experimental apparatus designed by the authors for measuring flowing film rate is presented which is composed of a microelectrode, milliammeter, lightwave oscilloscope and measuring electric circuit. The working principle of the apparatus is based on that fact that an electrolyte added to the flowing film to be measured flows with it at the same rate. A pair of microelectrodes specially adapted are installed in the flowing film so as to stay apart by a certain distance along its direction. The conductivity of the fluid medium is improved, thus inducing a change of signals in the measuring circuit as the electrolytic solution flows together with the flowing film. A complete process of the signal change may automatically be recorded with a lightwave oscilloscope, thus the time consumed by the electrolyte in passing through the electrodes can be accurately determined and calculation of the flowing film rate may be made possible through a standard formula. This apparatus can be used to measure a flowing film rate not only under general conditions, but also under a revolving force field.

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TITLE: "Centrifugal Separator for Beneficiation Iron Ore Slimes"

SOURCE: Beijing YOUSE JINSHU [NONFERROUS METALS] in Chinese No 2, 1981 pp 48-53

TEXT OF ENGLISH ABSTRACT: In 1964, a centrifugal separator was successfully developed by the Yunnan Tin Mining Company, China. Since then, this type of separator, simple in structure and reliable in operation, has been used for separating tungsten and tin ore slimes and has achieved good results.

Experiments conducted for many years showed that centrifugal separators can also be used successfully for separating iron ore slimes. A concentrator, treating 3 million tons of ore per year and built in 1975 at Gongchangling Iron Mine, Anshan Mining Company, has adopted the combined flowsheet of magnetic separation followed by gravitation (spiral chutes and centrifugal separators) for treatment of composite magnetite-martite ore. When treating the ore feed grading of 13.9 percent Fe, the centrifugal separator can produce a concentrate assaying 63.2 percent Fe with recovery of 43 percent Fe in this operation.

The centrifugal separator can also be utilized for other types of iron ore, the lower size limit for effective recovery being 10 microns.

AUTHOR: TIAN Encheng

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TITLE: "Measurement of Sintering Temperatures of Some Zinc Concentrates in Fluidized-bed Roasting"

SOURCE: Beijing YOUSE JINSHU [NONFERROUS METALS] in Chinese No 2, 1981 pp 60-64, 13

TEXT OF ENGLISH ABSTRACT: The crux of high temperature oxidizing roasting of zinc concentrates in a fluidized bed is controlling their sintering temperatures accurately. Having measured sintering temperatures of some zinc concentrates in fluidized-bed roasting, we proposed for the first time that the concentrates be classified into five categories by their sintering points, thus contributing to choosing the proper fluidized-bed roasting temperatures. The sintering points are of five kinds: superhigh, high, intermediate, low and ultralow. The factors affecting the sintering temperatures of zinc concentrates and approaches toward their improvement are also shown.

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ORG: Both of the Beijing Mining and Metallurgical Research Institute

TITLE: "Application of Mineralogy to Extractive Metallurgy--On the Recovery of Cobalt from Copper-Nickel Converter Slags"

SOURCE: Beijing YOUSE JINSHU [NONFERROUS METALS] in Chinese No 2, 1981 pp 65-71

TEXT OF ENGLISH ABSTRACT: Mineralogy and microstructure of the slow cooling cobalt matte from scavenging liquid converter slags by reduction and sulfidization in an electric furance are studied. Physical and chemical reactions during smelting are discussed based upon mineralogy of the matte and distribution of cobalt in the matte. It is shown on phase relations that cobalt matte containing 22-25 percent Fe and 20-22 percent S may be obtained and about 90 percent of the total cobalt can be reduced to the metallic phase by controlling conditions of reduction. As viewed from mineralogy, a process proposed by our institute is appropriate for recovery of cobalt from the converter slag. The process is as follows: reducing smelting in the electric furnace, slowly cooling the metallized cobalt matte, concentrating by flotation, sulfuric acid pressure leaching, separating of cobalt from nickel by P204 solvent extraction, reducing to cobalt powder with hydrogen, etc.

The mineral components of two cobalt mattes obtained using nickel-bearing pyrite and calcined nickel concentrate as a sulfidizing solvent are examined. The ratio of

[Continuation of YOUSE JINSHU No 2, 1981 pp 65-71]

nickel to cobalt in the matte is approximately 8:1 for the latter solvent and 3.5:1 for the former. In the case of the latter, precious metals Pt and Pd entrained into the alloy phase by the calcine are lost in the leaching slag. Furthermore, the sulfur in cobalt matte is less than 20 percent and the alloy assay of the matte is 45-50 percent, so that the melting point of the matte will rise greatly. Thus it is more suitable to adopt nickel-bearing pyrite as a sulfidization solvent in the electric furnace smelting than to adopt the calcine.

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TITLE: "Transportation of Iron Compounds through Gas-phase Reaction during the Reduction Process of $ZrCl_{4(g)}$ with Metallic Magnesium--Application of Chemical Thermodynamics to Metallurgy (I)"

SOURCE: Beijing YOUSE JINSHU [NONFERROUS METALS] in Chinese No 2, 1981 pp 72-79

TEXT OF ENGLISH ABSTRACT: The variations of the ratios n_{Fe}/n_{Zr}, n_{Hf}/n_{Zr}, n_{Si}/n_{Zr} and n_{Al}/n_{Zr} for zircon, intermediate and final products in the metallurgy of sponge zirconium demonstrated that Fe behaved rather differently than did the other impurities, i.e., Hf, Si and Al. Iron could "sneak into" sponge zirconium in the final reduction procedure of $ZrCl_{4(g)}$ with metallic magnesium. It has long been believed that interaction between reduced sponge zirconium and the stainless steel container was the main cause responsible for the super-contamination of sponge zirconium by iron. However, using zirconium containers instead of stainless steel ones could not stop sponge zirconium from being super-contaminated by iron. Thermodynamic calculations based on operational data revealed the presence of the transporting process of iron chloride through the gas-phase into the reduction container where iron was reduced and contaminated the sponge zirconium. Iron chloride was produced by reactions taking place between the $ZrCl_4$ vapor and iron oxide film

[Continuation of YOUSE JINSHU No 2, 1981 pp 72-79]

on surfaces of containers as well as reactors. In addition, the product hydrolyzed, $ZrOCl\cdot 8H_2O$, entering the reactors would be responsible for the formation of iron oxide film on these surfaces.

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TITLE: "Behavior of Sodium Sulfate during Roasting of Copper Sulfide Concentrates"

SOURCE: Beijing YOUSE JINSHU [NONFERROUS METALS] in Chinese No 2, 1981 pp 80-84, 79

TEXT OF ENGLISH ABSTRACT: In small copper hydrometallurgical plants, the roasting-leaching-electrowinning route is generally followed. The clarification of pulp after leaching is prompted by adding in situ polyacrylamide into the leaching tank equipped with a mechanical agitator. Concerning the treating of some types of copper concentrates containing much calcium and magnesium (in the form of carbonates), due to insufficient decomposition of these carbonates during roasting, it is obvious that evolution of bubbles in the course of clarification of the pulp will seriously hinder the clarification. This causes considerable trouble in the leaching operation. In order to promote the decomposition of those carbonates and convert them into sulfates, it is necessary to raise the temperature of roasting, but this will lead to the formation of much copper ferrite.

In the roasting process, by adding 1.3 - 1.7 percent mirabilite into the fluid bed roaster feeds, we succeeded in raising the roasting temperature by 50-80°C. Mirabilite appears to play a certain role in promoting copper sulfation during

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roasting at higher temperatures, and promoting sulfation of calcium and magnesium carbonates, resulting in the reduction of bubbling in the clarification of pulp.

During roasting sodium sulfate can increase the particle size of calcine by congregating the calcine particles together, thus reducing the dust formation during fluid-bed roasting.

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Shipbuilding

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TITLE: "On the Trend toward the Development of the Push-train of the Lower Changjiang River in the Near Future"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [SHIPBUILDING OF CHINA] in Chinese No 3, Jul 81 pp 34-45

TEXT OF ENGLISH ABSTRACT: This paper describes a large amount of technical and economical analysis of push-trains of the lower Changjiang River. These analyses were conducted by the authors with the aid of a computer.

The comprehensive economic index E is used to assess the economic effect of the push-train scheme, while the resistance of the push-train is calculated with a new method proposed by the authors. The influence of the structure of the transportation cost on the economy of the push-train is analyzed in terms of the optimum

[Continuation of ZHONGGUO ZAOCHUAN No 3, Jul 81 pp 34-45]

matching functional relationship among the power of a pusher, crew wage, number of pushers and fuel cost per ton, as well as the data of calculation of many examples. It is indicated that the structure of the transportation cost of the push-train is one of the decisive factors determining both the power of a pusher and the scale of a push-train. Based on the results of calculations and analyses of more than 20,000 schemes, the paper points out that according to the structure of the transportation cost and the annual freight throughput of the lower Changjiang River at the present time and in the foreseeable future, it can achieve an optimum economic effect in developing the 2 x 4 push-train (of the 2000 t. barge), consisting of 1200-1800 horsepower pushers, and the 2 x 2 push-train (of the 2000 t. barge), consisting of 540-1200 horsepower pushers on the lower Changjiang River now and in the near future.

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TITLE: "A Method for Calculating Wave-induced Bending Moment on Sea-going Ship Hulls"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [SHIPBUILDING OF CHINA] in Chinese No 3, Jul 81 pp 55-64

TEXT OF ENGLISH ABSTRACT: In this paper, the predicted wave-induced bending moment for six groups of ships was calculated by using the strip method and statistical wave information of the North Atlantic. Each of the groups consists of 30 ships of the same length with the characteristics of these ships corresponding to those of 30 existing ships, including dry cargo ships, bulk carriers, tankers and passenger ships, etc. The ship lengths of the six groups are 100 m, 150 m, 200 m, 250 m, 300 m and 350 m respectively.

Based on an analysis of the effects of ship length and block coefficient, a simple formula for calculating the wave-induced bending moment has been suggested. It is similar to that used in Classification Societies Rules and could be used as a reference for ship design.

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